PATENT SPECIFICATION

NO DRAWINGS

1,178,621

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Date of Application (No. 11062/67) and filing Complete Specification: 9 March, 1967.

Application made in United States of America (No. 533,841) on 14 March, 1966.

Complete Specification Published: 21 Jan., 1970.

Index at acceptance:—B5 N(17Y, 170, 230, 238, 316, 493, 497, 500, 502, 503, 54X, 55X, 69Y, 698, 750, 756)

International Classification:—B 32 b 23/04

COMPLETE SPECIFICATION

Coating Processes

We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America, of 343, State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to coating processes.

According to the present invention there is provided a process of coating a substrate with a thermo-plastic extrudable curtain coating composition comprising 70 to 90% by weight of cellulose acetate butyrate and 10 to 30% by weight of one or more of the plasticizers triethyl citrate, di(2-ethylhexyl)adipate, di(2-ethylhexyl)phthalate and diisodecyl adipate, the process comprising heating the composition to a hot melt coating consistency at a temperature of at least 250°F. and a pressure of at least 50 psi, extruding the resulting molten composition through a long narrow extrusion orifice to produce a falling curtain of the molten composition, depositing the curtain on a substrate having relative movement in a coating relationship, cooling the coating on the substrate, and recovering the substrate with a solid coating of the composition.

The substrate will normally support at least one article which will be packaged by this curtain coating process.

Also according to the present invention, there is provided a package comprising an air-permeable substrate, an article of manufacture supported on that substrate, and a solid continuous coating conforming approximately to the upwardly and outwardly facing surfaces of the article and of the substrate near the article, the coating binding said article to said substrate and having been applied by a process as described above. A suitable air-permeable substrate is paperboard.

Curtain coating processes of this kind are further described in Patent Application No. 8989/63 (Serial No. 1,031,479).

Cellulose acetate butyrate is a well-known cellulose ester which is prepared by known procedures. The final products for use in the present invention preferably contain not more than about 2% by weight of free hydroxyl, and have a viscosity of about 0.5 to 30 seconds. (ASTM method D—1343—54T is used for measuring viscosities in poises, using a solution such as that of Formula A, ASTM D—871—54T. The viscosities in poises are converted to seconds as described in ASTM D—871—48). The combined butyryl content of the cellulose acetate butyrate is preferably at least 35% by weight.

Stabilizers may optionally, be added to the composition to provide protection against degradation due to heat, oxidation, and the presence of foreign substances. The stabilizers are those well-known in the art and include materials such as acid acceptors, anti-oxidants, and buffering agents. Specific substances which have been found useful in this regard are the epoxides, such as epoxidized soybean oil, and phenolic anti-oxidants. The amount of stabilizer which is employed in the composition is small and normally does not exceed about 2—3% by weight of the cellulose ester resin present in the composition.

Dyes are frequently employed in order to provide the composition with the desired tint. The most common reason for incorporating a dye in the composition is to provide the composition with an optimum whiteness. Other dyes may be incorporated to provide any desired colour or tint. These dyes include a wide variety of azo dyes or anthraquinone dyes. The concentration of such dyes, in general, is less than about 100 parts per million, based on the weight of the total composition.

Extender resins, or fillers, may be employed to reduce the cost of the coating composition

even further. Materials which have been found useful for this purpose are polymers of alpha-methyl styrene and sucrose acetate isobutyrate.

These extender resins are employed in amounts up to about 20% by weight of the total composition. At levels above that concentration, the film properties of the composition may be adversely affected and, accordingly, this sets a guideline for the upper limit of such materials.

Another substance which may be added to the composition is an adhesion-promoting agent. There are certain substrates which are not as receptive to unmodified cellulose ester compositions as would be desirable and useful adhesion-promoting agents include the maleates, such as neopentyl glycol maleate, and low molecular weight vinyl acetate polymers. The concentration of adhesion-promoting agents is preferably at least equal to that of the plasticizer for there to be any noticeable improvement in the adhesion of the composition to the particular substrate involved.

The compositions used in the process of this invention are designed to be employed in extrusion machines at temperatures from about 250°F to about 450°F, and at a pressure of 75 to 500 psi. If the compositions are employed at temperatures higher than about about 450°F for prolonged periods of time, the molten plastic tends to degrade, as indicated by a darkening in the colour of the molten composition, a drop in its melt viscosity, and a decrease in the low temperature properties of the extruded coating. If the composition is maintained in the extrusion device at a temperature over 450°F, the life of the molten composition in the machine would fall from an acceptable level of 1.5 to 2 hours to about one-half to three-quarters of an hour. At these elevated temperatures above 450°F, the stability of the molten composition is not sufficient to be employed successfully in the curtain coating process; furthermore, the rate of loss of plasticizer from the molten curtain becomes a limiting factor. Typical conditions for a preferred process are 375°F and 150 psi.

Another consideration which relates to the properties of the compositions used in the process of this invention is its melt viscosity. The unplasticized resin has a melt viscosity which is too high for operation in such a process. Thus, it is important that a plasticizer be employed. This plasticizer functions by dissolving the cellulose ester as the composition is heated and thereby reduces the melt viscosity of the composition. When the hot, molten composition is extruded as a curtain, the viscosity increases due to at least two effects; namely, the cooling of the resin and the loss of plasticizer by evaporation from the hot curtain. By regulating the various operating conditions of a curtain coating process, compositions of a wide range of melt viscosities can be employed. The melt viscosity ranges from 20,000 to 175,000 centipoises, with the preferred range being from 50,000 to 125,000 centipoises. At viscosities greater than about 175,000 centipoises, there is a problem of melt fracture introduced by the pumping means employed to recycle the molten plastic material from the region of the coating back to the extrusion device for reuse. When a molten composition of such a high viscosity is subjected to mechanical working, the shearing of the composition by reason of the mechanical pumping may actually cause a breakdown in the molecules of the composition and thereby cause a drop in melt viscosity which, in turn, produces a film of inferior properties.

In the following examples, several compositions are shown which provide different combinations of properties, although all the compositions were found to be well-suited for use as the coating resin in a curtain coating process. Parts and percentages are by weight, unless otherwise specified.

In Table I there is a description of the various cellulose ester materials employed in the compositions tested in the Examples. The viscosity of the cellulose ester material was determined in accordance with ASTM Test Method D 1343—54T. Four different grades of cellulose acetate butyrate are identified as CAB—1 to CAB—4.

TABLE I

Thermoplastic Material	Weight % Propionyl	Weight % Butyryl	Number of Hydroxyls per unit of Anhydroglucose	Viscosity (Seconds)
CAB—1	—	38	1	20
CAB—2	—	38	1	2
CAB—3	1	50	0	5
CAB—4	—	50	0	1

In Table II are shown some properties of two different compositions which were prepared employing two of the materials described in Table I, and incorporating various other components in the preparation of the composition. Example 1 relates to a composition containing 53 parts of CAB—3, 47 parts of CAB—4, and 19 parts of di(2-ethylhexyl)-adipate. Example 2 relates to a composition containing 100 parts of CAB—3 and 18 parts of di(2-ethylhexyl)adipate. It is advantageous, for reasons explained hereinabove, to include of the order of 0.1 to 5 parts of a stabilizer and of the order of 1 to 100 parts per million of a dye. Tensile strength and elongation were determined by standard methods on a Thwing-Albert Tensile Tester, with the tensile samples being pulled at a rate of 2″ per minute using a 20 lb. or a 50 lb. load. Low temperature brittleness was determined by placing film strips in a Scott Brittleness Tester containing Freon and dry ice, and subjecting the film strips to a right angle bend at various temperatures until 50% of the specimens failed. (Freon is a Registered Trade Mark). Melt viscosity of the composition was determined in accordance with ASTM Test Method D 1238—57T, with the extrusion Plastometer being controlled at 190°C, having an orifice size of 0.400″ ± 0.0002″, and having the total weight of the piston and its load at 325 grams.

Preferred compositions used in the invention have tensile strengths of from 900 to 3000 psi and low temperature brittleness of −50°F to −20°F.

TABLE II

Example	Tensile Strength psi	Elonga-tion, %	Melt Viscosity at 375°F. cps	Approx. Melt Stability hrs.	Low Temperature Brittleness at −10°F
1	2300	15	50,000—60,000	2	Passed
2	2500	20	110,000—130,000	1.5	Passed—at −70°F.

WHAT WE CLAIM IS:—

1. A process of coating a substrate with a thermo-plastic extrudable curtain coating composition comprising 70 to 90% by weight of cellulose acetate butyrate and 10 to 30% by weight of one or more of the plasticizers triethyl citrate, di(2-ethylhexyl)adipate, di(2-ethylhexyl) phthalate and diisodecyl adipate, the process comprising heating the composition to a hot melt coating consistency at a temperature of at least 250°F. and a pressure of at least 50 psi, extruding the resulting molten composition through a long narrow extrusion orifice to produce a falling curtain of the molten composition, depositing the curtain on a substrate having relative movement in a coating relationship, cooling the coating on the substrate, and recovering the substrate with a solid coating of the composition.

2. A process as claimed in Claim 1 and substantially as hereinbefore described.

3. A coated substrate prepared by a process as claimed in Claim 1.

4. A package comprising an air-permeable substrate, an article of manufacture supported on that substrate, and a solid continuous coating conforming approximately to the upwardly and outwardly facing surfaces of the article and of the substrate near the article, the coating binding said article to said substrate and having been applied by a process as claimed in Claim 1.

5. A package as claimed in Claim 4, wherein the substrate is paperboard.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1970.
Published by the Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.